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Quantum Communication Through an Unmodulated Spin Chain

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abstract We propose a scheme for using an unmodulated and unmeasured spin-chain as a channel for short distance quantum communications. The state to be transmitted is placed on one spin of the chain and received later on a distant spin with some fidelity. We first obtain simple expressions for the fidelity of quantum state transfer and the amount of entanglement sharable between any two sites of an arbitrary Heisenberg ferromagnet using our scheme. We then apply this to the realizable case of an open ended chain with nearest neighbor interactions. The fidelity of quantum state transfer is obtained as an inverse discrete cosine transform and as a Bessel function series. We find that in a reasonable time, a qubit can be directly transmitted with better than classical fidelity across the full length of chains of up to 80 spins. Moreover, the spin-chain channel allows distillable entanglement to be shared over arbitrarily large distances.